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U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF AGRICULTURAL SOILS.

SOIL MOISTURE.

A RECORD OF

THE AMOUNT OF WATER CONTAINED IN SOILS

DURING THE

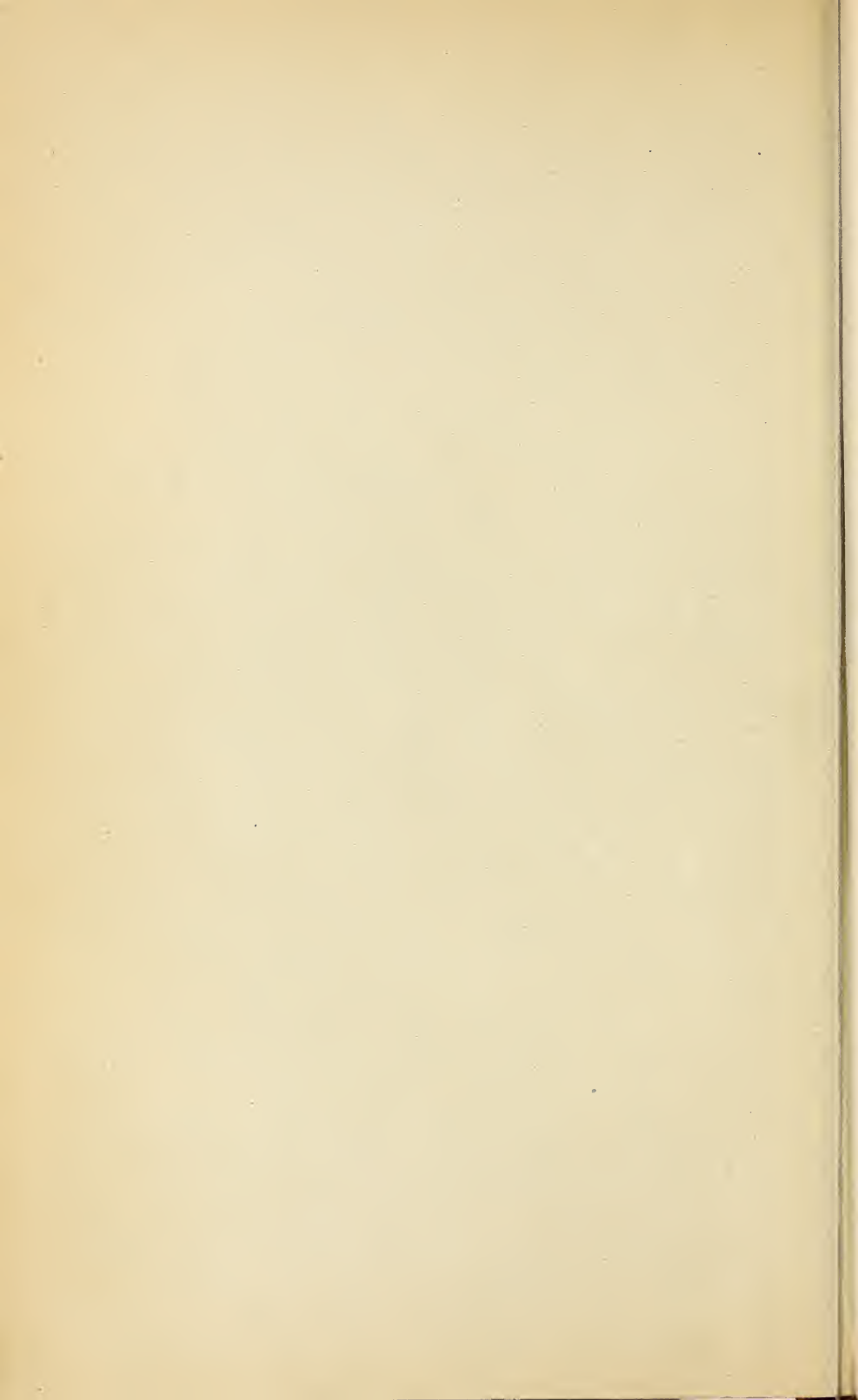
MONTH OF JULY, 1895.



WASHINGTON:

GOVERNMENT PRINTING OFFICE.

1895.



U. S. DEPARTMENT OF AGRICULTURE.
DIVISION OF AGRICULTURAL SOILS.

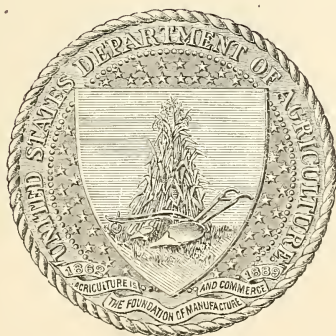
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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF AGRICULTURAL SOILS,
Washington, D. C., November 11, 1895.

SIR: I have the honor to transmit herewith data showing the amount of moisture in the soils of a number of localities in the United States during the month of July, with brief notes as to the character of the season and the crop condition.

The investigations of the texture and moisture conditions of some of the important soils which have been studied this year have been carried so far that some generalizations seem permissible. Accordingly the texture of the soils adapted to truck, grass, and three different types of tobacco is described in this bulletin as the principal cause of the marked difference in the amount of moisture found in the soils. It is further stated that the well-known difference in the agricultural value of these several kinds of soils and their adaptation to certain crops is largely due to the relative amount of water which these soils maintain for crops.

The records for August do not differ materially from those which have been reported in this and in previous bulletins. While the moisture differs in the same soil from day to day and from week to week, the difference is proportionally the same on all the soils, showing that throughout the season crops growing on some soils have two or three times as much water at their disposal as on others under essentially the same climatic conditions. This point having been established it will not be necessary to publish more of these preliminary records at present.

Very respectfully,

MILTON WHITNEY,
Chief of Division.

Hon. J. STERLING MORTON,
Secretary of Agriculture.

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THE WATER CONTENT OF SOILS DURING THE MONTH OF JULY.

SUMMARY OF CONDITIONS DURING THE MONTHS OF MAY AND JUNE.

The soil conditions during the months of May and June presented some curious phenomena. During the latter half of May, over which the records were reported, the conditions in the soils of the arid region were reported as extremely dry. At the East, in the truck, tobacco, and grass lands of the Atlantic Coast States, the conditions were reported as extremely favorable for these crops, inclined even to be rather wet over portions of the time. In June the situation was just reversed. On the last day of May and the first two days of June rain fell throughout Kansas and Nebraska, followed by frequent showers throughout the month, so that the conditions throughout June were reported as generally very favorable for crops produced in those localities. The fall-planted crops had been greatly delayed on account of the drought prevailing throughout the spring, and on account of the dry-soil conditions the spring-planted crops could not be put out until later than usual, except on irrigated fields. The first of June, therefore, marked the beginning of spring and of farming operations for the States of Kansas and Nebraska. In the truck, tobacco, and grass lands of the Eastern States the soil conditions during June were very dry, and great injury was reported in consequence from many localities. The drought was so severe that the pastures dried up even in the finest type of grass land. These unfavorable conditions were graphically shown in the charts accompanying Bulletin No. 2 of this division.

CONDITIONS DURING THE MONTH OF JULY.

The soil conditions prevailing during the month of July were generally favorable throughout all the localities from which records were obtained. In western Kansas and Nebraska there were frequent and abundant showers, so that at most of the localities at which observations were taken no irrigation was needed, and the crops were reported as making a very luxuriant growth. In the Eastern States the conditions were generally reported favorable from the localities at which the records were kept.

MOISTURE CONDITIONS IN TRUCK AND GRASS LANDS.

In Bulletin No. 2 reference was made to the fact that the early truck of the Atlantic Seaboard is grown upon a very characteristic type of soil. These truck soils are light and sandy, and from the old agricultural standpoint are poor and unproductive for the staple farm crops. The pasture grasses, on the other hand, for their best development require the strongest type of agricultural land. Two localities were selected for the comparison of the conditions prevailing in these two markedly different types of soil. Toano, Va., was selected for the truck, and Lexington, Ky., for the grass land. There have been sufficient data collected now to warrant some generalizations, and the following data is given as an explanation of the cause of the marked difference in agricultural value of these two soils and of their peculiar adaptation to these different kinds of crops and agricultural interests.

The accompanying table gives the mechanical analyses of a sample of subsoil of the truck land at Toano, Va., and of the grass land at Lexington, Ky.

Texture of land adapted to extreme types of agricultural crops—truck and grass.

No.	Diameter of soil grains.	Conventional names.	371. Toano, Va., truck land, 6-24 inches.	287. Lexington, Ky., grass land, 7-24 inches.
			Per cent.	Per cent.
	<i>Millimeters.</i>			
1	2-1.....	Fine gravel.....	0.06	1.76
2	1-0.5.....	Coarse sand.....	0.46	1.63
3	0.5-0.25.....	Medium sand.....	7.08	1.24
4	0.25-0.1.....	Fine sand.....	48.43	0.58
5	0.1-0.05.....	Very fine sand.....	26.20	1.59
6	0.05-0.01.....	Silt.....	8.52	46.36
7	0.01-0.005.....	Fine silt.....	3.20	9.56
8	0.005-0.0001.....	Clay.....	4.55	30.20
	Total mineral matter.....		98.50	92.92
9	Loss at 110° C.....		0.15	4.29
10	Loss on ignition.....		1.10	5.32
	Total.....		99.75	102.53

It will be seen that the soils differ very markedly in their texture. The truck soils of the Atlantic Coast contain from 1 to 10 per cent of clay. As a rule, the less clay they contain the earlier the crops mature, which is the most important element in truck farming. A soil containing between 4 and 5 per cent of clay, as shown in this sample, is an average truck soil adapted to any of the usual truck crops. The truck soils, as a rule, consist of from 70 to 85 per cent of the different grades of sand. The finest type of grass land in the Eastern States, on the other hand, contains a very much larger percentage of clay. It contains not more than 5 or 10 per cent of the various grades of sand and from 28 to 50 per cent of clay.

On account of this marked difference in the texture of these soils, they maintain, even with the same rainfall, very different conditions of moisture, and this adapts them to different classes of crops.

The trucking interest depends upon the early maturity of vegetables and small fruits, so that they can be put upon the market before there is competition from other soils of the State. It is carried on under a very intense system of cultivation. The value of the truck crops of Maryland is about equal to the value of the wheat crop and nearly equal in value to the corn crop, but the truck farming is confined to a narrow belt of land along the coast and Chesapeake Bay, and in the aggregate there is not more than one-tenth of the corn acreage devoted to this interest. This is without considering the market gardening around the larger cities and the production of fruits, which would very materially increase the relative importance of this class of agricultural crops without greatly extending the acreage.

These truck soils do not yield as much per acre nor is the quality of the crops produced as fine as on the heavier soils of the State, but vegetables can be forced to mature early and be placed upon the market during the winter and early spring months sometime before they can be matured upon the heavier soils.

The principal reason for this and the explanation of the peculiar adaptation of these soils to truck farming is to be found in the open, loose texture of the soils and the small, but uniform, supply of water they maintain for the crops.

The pasture grasses represent the other extreme of agricultural interests and require, as was stated, the richest and finest type of agricultural lands. A pasture grass rarely needs to mature seed. It needs a soil in which there is an abundant and uniform supply of moisture to promote a continuous and luxuriant vegetable growth, with little tendency to produce fruit. On our heaviest limestone soils all kinds of cultivated crops are inclined to make a luxuriant growth, to be slow in maturing, and to produce a relatively small yield of grain or fruit in proportion to the weight of dry matter produced. The agricultural value of these lands is largely dependent upon the close texture of the soil and the large and uniform supply of water they maintain for the crops.

When rain falls upon these two types of soil, it continues to soak through the soils until it reaches sea level, unless indeed it is used by plants or evaporated from the surface of the ground. The rate with which it moves downward through these soils is, however, very different on account of the variance in texture. In the light, sandy soil the spaces between the grains are relatively large, and the rain moves downward without much friction. In the heavy, clay soils, on the other hand, with less than 10 per cent of sand, the movement is extremely slow, as the water has to move down through an innumerable number of spaces between the fine grains of clay, and the friction or the resistance is very great. With the same rainfall, therefore, over each of these soils, on account of the greater friction and the slower movement in the clay soil that type of land will maintain two or three times as much

water as is contained in the truck soil. The effect of this is very apparent in the yield, texture, and other qualities of the crop.

The following table shows the amount of moisture in these two types of soil for the months of June and July:

Per cent of moisture in soils adapted to truck and grass.

Date.	June.		July.		Date.	June.		July.	
	Truck.	Grass.	Truck.	Grass.		Truck.	Grass.	Truck.	Grass.
1.....	9.5	20.2	10.3	21.1	18.....	7.8	19.3	9.8	18.1
2.....	9.4	20.1	10.4	21.3	19.....	7.8	19.2	9.1	18.0
3.....	9.3	20.0	9.7	20.7	20.....	7.7	19.3	8.2	18.1
4.....	9.2	19.9	9.0	20.1	21.....	7.7	20.5	7.6	18.8
5.....	9.0	19.8	8.2	19.7	22.....	7.6	21.5	7.0	20.0
6.....	8.9	19.7	7.9	19.7	23.....	7.5	21.4	6.2	21.4
7.....	8.8	19.6	8.2	20.0	24.....	7.4	20.7	6.2	22.4
8.....	8.7	19.4	8.7	20.2	25.....	7.4	20.1	7.5	23.1
9.....	8.6	19.3	9.3	20.6	26.....	7.7	20.3	9.1	23.1
10.....	8.5	19.2	9.4	20.8	27.....	8.5	19.7	8.9	22.8
11.....	8.4	19.2	9.6	20.9	28.....	10.3	19.3	8.5	22.3
12.....	9.2	19.2	9.3	20.7	29.....	10.5	19.1	8.0	21.8
13.....	9.8	19.1	9.1	20.3	30.....	9.1	19.6	7.2	21.2
14.....	9.8	19.1	9.0	19.8	31.....	-----	-----	6.5	20.7
15.....	9.2	19.3	9.6	19.2	Mean..	8.7	19.7	8.6	20.4
16.....	8.5	19.4	10.2	18.2					
17.....	8.1	19.5	10.1	18.3					

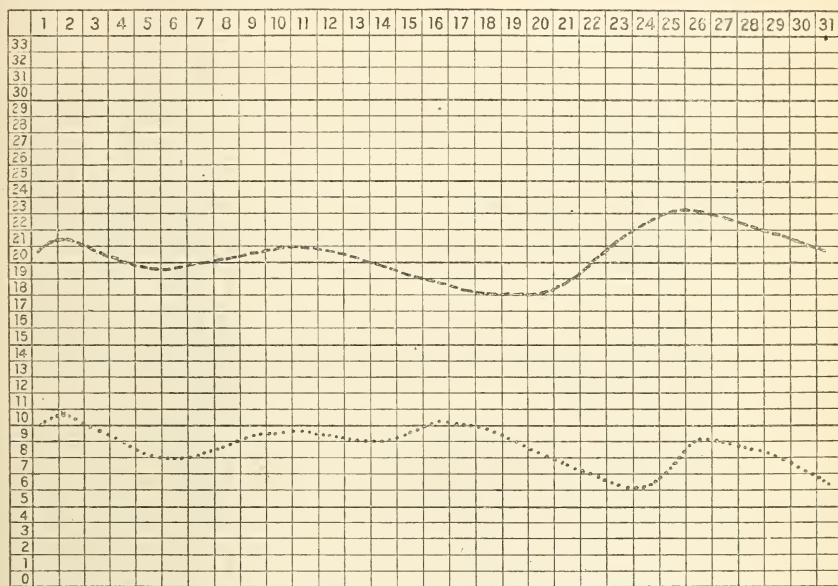
These figures are not those obtained from the daily samples, for the actual determinations vary considerably with the inequalities of the ground and from the errors arising from the methods of moisture determinations. The actual determinations are plotted on a chart, and the figures in the table are taken from the chart as representing more nearly the average daily conditions of the field.

The conditions in the truck soil were reported as generally favorable throughout the month of June. In the uncultivated grass land the conditions were quite uniform, as seen, but under the pasture sod the amount of water was reduced to about one-half of that on the bare, uncultivated land. The conditions were represented as generally favorable throughout the month of July for the respective crops of each locality. It will be seen that in the month of June there was, on the average, 8.7 per cent of moisture in the truck soil. The highest was 10.5 on the 29th, and the lowest 7.4 on the 24th and 25th. There was on the average 19.7 per cent of moisture during the same time in the grass land, and the conditions were reported as rather dry. The largest amount was 21.5 per cent, and the smallest amount was 19.1 per cent on June 13, 14, and 29. These records were both taken from bare, uncultivated soil, so that the conditions of the observations would be the same and the observations comparable. In July, when the conditions were reported as quite favorable in each locality for the respective crops, there was an average of 8.8 per cent of moisture in the truck soil, the extreme being 10.4 to 6.2 per cent. In the grass land there was an average of 20.4 per cent, with extremes of 23.1 to 18 per cent.

Observations taken at Mardela Springs, Md., representing the lighter truck soils of eastern Maryland, show an average water content for July of 6.5 per cent, with a range from 10.3 to 4.5 per cent. Observations taken elsewhere in the truck and grass areas confirm the facts here presented, and indicate that our typical truck soils maintain on an average from 5 to 10 per cent of moisture, while our strongest types of grass land maintain on an average from 18 to 22 per cent of water.

The accompanying chart shows graphically the difference in the amount of water contained in these two types of land during the month of July. The records for June when plotted show precisely the same

Per cent of moisture in truck and grass land in July.



Early truck land

Grass land -----

relative position of the curves. It is very evident that this difference in the water content, due to the difference in texture of the soils, is the principal reason for the peculiar agricultural value of these two markedly different types of land.

MOISTURE CONDITIONS IN DIFFERENT TYPES OF TOBACCO SOIL.

The accompanying table gives the mechanical analyses of three soils, each adapted to a different class of tobacco—the bright tobacco of North Carolina; the dark, heavy shipping tobacco of Kentucky; and the coarse, rank, white burley tobacco of Kentucky.

Texture of soils adapted to three types of tobacco.

No.	Diameter of soil grains.	Conventional names.	117. Oxford, N. C., bright to- bacco, 12-16 inches.	1099. Newstead, Ky., ship- ping to- bacco, 6-18 inches.	287. Lexington, Ky., burley tobacco, 7-24 inches.
	<i>Millimeters.</i>		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
1	2-1.....	Fine gravel.....	0.71	0.05	1.76
2	1-0.5.....	Coarse sand.....	1.12	0.18	1.63
3	0.5-0.25.....	Medium sand.....	7.37	0.11	1.24
4	0.25-0.1.....	Fine sand.....	27.90	0.34	0.58
5	0.1-0.05.....	Very fine sand.....	24.26	5.13	1.59
6	0.05-0.01.....	Silt.....	22.77	63.28	46.36
7	0.01-0.005.....	Fine silt.....	4.20	5.19	9.56
8	0.005-0.0001.....	Clay.....	8.30	20.55	30.20
	Total mineral matter.....		96.63	94.83	92.91
9	Loss at 110° C.....		2.07	2.10	4.29
10	Loss on ignition.....		0.15	3.06	5.32
	Total.....		98.85	99.99	102.52

It will be seen that the texture of these samples is very different. The samples represent very uniform soil areas, upon which these different classes of tobacco are grown. Samples of the bright-tobacco soils have been examined from a great many localities in Virginia, North and South Carolina, and East Tennessee, and their texture is remarkably uniform. They contain from 4 to 10 or 12 per cent of clay. As a rule, the less clay they contain the finer the texture and the brighter the color that can be given to the tobacco in curing. Such light soils, however, produce but a small yield per acre, and there is a limit of profitable production beyond which the finer quality does not compensate for the smaller yield.

The dark, heavy, shipping tobaccos of Kentucky are grown upon a soil of medium texture, containing on an average about 20 per cent of clay. The sample selected as representing this grade of land is from the barrens formation at Newstead, Ky., and contains considerably more silt than is usually found in these soils. The burley tobacco is grown upon the rich limestone soils, which can hardly be too rich and productive for this class of tobacco. These soils contain from 30 per cent of clay upward.

Per cent of moisture in soils adapted to three different types of tobacco.

Date.	June.			July.		
	Bright tobacco.	Shipping tobacco.	Burley tobacco.	Bright tobacco.	Shipping tobacco.	Burley tobacco.
1.....	10.6	16.7	20.2	11.3	16.6	21.1
2.....	10.4	16.5	20.1	11.7	17.5	21.3
3.....	10.0	16.3	20.0	11.2	16.8	23.7
4.....	9.5	16.4	19.9	10.7	15.5	20.1
5.....	9.0	16.7	19.8	10.0	15.1	19.7
6.....	8.5	17.0	19.7	9.1	15.2	19.7
7.....	8.5	16.6	19.6	8.3	16.0	20.0
8.....	8.6	15.9	19.4	7.6	17.3	20.2
9.....	8.2	15.2	19.3	7.0	17.9	20.6
10.....	7.7	14.6	19.2	6.3	17.5	20.8
11.....	7.3	14.6	19.2	5.9	17.1	20.9
12.....	7.3	14.8	19.2	5.5	16.8	20.7
13.....	7.5	14.2	19.1	5.3	16.2	20.3
14.....	7.6	14.2	19.1	5.1	15.7	19.8
15.....	7.5	14.5	19.3	4.9	15.3	19.2
16.....	7.3	14.0	19.4	4.8	14.9	18.8
17.....	7.1	13.6	19.5	4.6	14.4	18.3

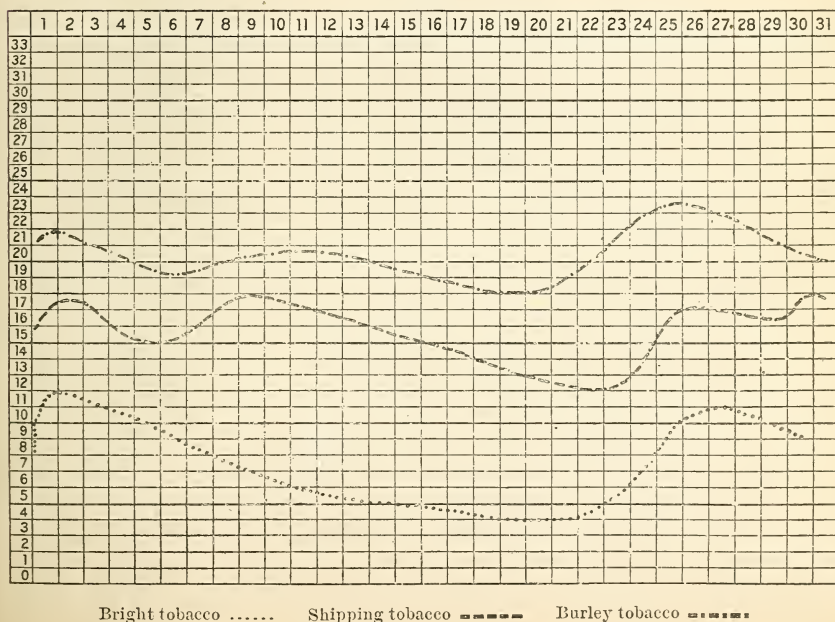
Per cent of moisture in soils adapted to three different types of tobacco—Continued.

Date.	June.			July.		
	Bright tobacco.	Shipping tobacco.	Burley tobacco.	Bright tobacco.	Shipping tobacco.	Burley tobacco.
18.....	6.8	13.7	19.3	4.2	13.7	18.1
19.....	6.5	13.7	19.2	4.0	13.2	18.0
20.....	6.2	13.1	19.3	4.0	12.8	18.1
21.....	5.8	12.4	20.5	4.0	12.3	18.8
22.....	5.5	12.7	21.5	4.5	12.1	20.0
23.....	5.2	13.2	21.4	5.5	12.3	21.4
24.....	4.8	13.2	20.7	7.0	13.6	22.4
25.....	4.5	12.8	20.1	9.5	16.4	23.1
26.....	4.3	13.0	20.3	10.6	17.1	23.1
27.....	4.2	13.7	19.7	11.0	16.9	22.8
28.....	4.2	13.3	19.3	10.5	16.7	22.3
29.....	4.3	13.3	19.1	10.0	16.4	21.8
30.....	5.5	14.8	19.6	9.1	17.5	21.2
31.....					17.5	20.7
Mean.....	7.0	14.5	19.7	7.4	15.6	20.5

The accompanying table gives the daily moisture content of these three types of tobacco soils for the months of June and July, the soil from Lexington, Ky., being used as a representative both of the grass and the white burley-tobacco land. In June the bright-tobacco soil contained on an average, to a depth of 12 inches, 7 per cent of moisture; the shipping tobacco soil 14.8 per cent, and the burley-tobacco soil 19.7 per cent. In July the average moisture content of the three soils was about the same.

The data for July is shown graphically in the accompanying chart. The three curves have the same relative position as shown in the records for June, published in Bulletin No. 2 of this division.

Diagram showing the per cent of moisture in three types of tobacco land during month of July.



The soils adapted to each of these classes of tobacco differ so much in their texture and in their general appearance that it is easy for anyone with a little experience in such matters to recognize and classify them from a casual inspection and from the general appearance of the soil.

The typical "bright tobacco" can not be produced upon a soil having the same texture and maintaining the same moisture conditions as the shipping-tobacco soil here represented. The leaf would be coarse in texture and would not take on a golden color in curing, which gives character to the bright tobacco. On the other hand, a dark shipping leaf can not be produced upon the bright-tobacco soils, although it is easy to darken the leaf and make it coarser by changing the soil conditions through the application of manures and fertilizers. The texture of the soil adapted to each of these three classes of tobacco is very uniform, but there is a characteristic distinction between the classes, and the amount of water maintained by the various soils is quite different. When this amount of water is materially changed, either by artificial means or by the character of the season, the character of the crop produced is also materially modified and changed. The conclusion seems fully justified that the peculiar agricultural value of each of these three types of soil and their adaptation to one or the other of these three types of tobacco are very largely dependent upon the texture of the soil and upon the water supply which it maintains, which determines the peculiar development of the plant and the texture and quality of the leaf.

REPORTS FOR THE MONTH OF JULY.

The character of the soil conditions and of the season are referred to under the charts for the respective localities. Data is given from two localities in the truck area, one each in Maryland and Virginia. The moisture condition adapted to this interest is when the soil contains from 5 to 10 per cent of water, calculated on the moist material. When the supply falls below 5 per cent, the crop suffers, as a rule, from lack of moisture. When the supply exceeds 10 per cent, the soils are rather too wet for cultivation and too moist for the best development of truck crops, except during the early stages of growth.

The bright-tobacco soils have nearly the same texture as the truck soils, and maintain about the same amount of moisture for the crops. This amount should not much exceed 10 per cent, except when the crop is actively growing, and should not fall below 5 per cent.

The observations taken in the soil at Poquonock are believed to represent the typical conditions of the soils of the Connecticut Valley, which produce the fine-textured, light-colored cigar wrappers adapted to our home markets, of the same general type as the Sumatra tobacco. It will be seen that the moisture conditions in these tobacco soils are quite similar to the conditions in the bright-tobacco lands of the South, and to the truck soils of the Atlantic Seaboard. Indeed, these tobacco soils of the Connecticut Valley are typical truck soils, and are used extensively for this purpose. It was shown last season

that in the tobacco soils of Pennsylvania, where the Cuban type of tobacco is produced, which is larger, heavier, and coarser in texture than the Sumatra, there were two or three times as much moisture as in the light-tobacco soils of the Connecticut Valley.

The records from Greendale and Lexington, Ky., show, as did the June records, the great drain that pasture grasses are upon the moisture content of the soil.

The subsoiled plots, which have been studied during this season in Kansas, give hardly a fair idea of the effect of subsoiling, for the work was done when the land was extremely dry, and in some cases at least it was poorly done, on account of the dryness of the soil. It was done immediately before the observations were commenced, and several weeks before a soaking rain occurred to wet the soil. Since then the season in Kansas up to the last of July has been exceedingly favorable owing to the frequent showers. Under these conditions the subsoiling could hardly have been expected to show any material changes in soil conditions.

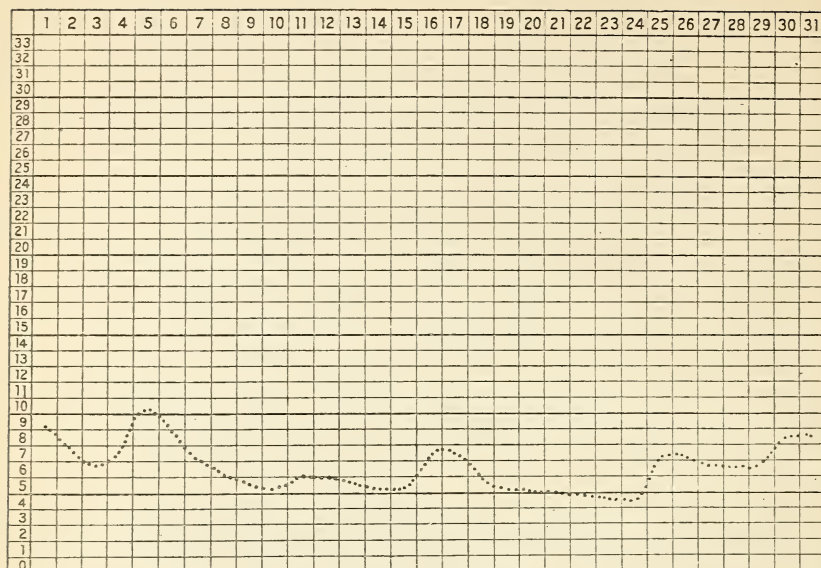
At Geneva, Nebr., where the subsoiling had been thoroughly done some time before the observations were commenced, and where the soil had been thoroughly wet by subsequent rains, the amount of moisture has been materially greater throughout the season than under ordinary conditions of cultivation.

WHAT THE DIAGRAMS MEAN.

In the illustrations the vertical columns mark the days of the month, as indicated by the figures at the top of the diagram. The horizontal lines running across the diagram represent the percentage of moisture in the soil, as indicated in the column of figures on the left-hand side of the illustration, extending from 0 to 33 per cent. As a guide to the eye, the lines representing every 5 per cent of moisture are made heavier.

The records for each day of the month are put upon the form in their appropriate places. Thus, if on the first day of the month there is 8 per cent of moisture in the soil, a mark is placed in the column representing that day at a height corresponding to the figure 8 on the left-hand side of the page. If on the next day there is 12 per cent of moisture in the soil, a mark is made in the next column at a height corresponding with the figure 12, and so on for each day of the month. When these marks have all been placed, a permanent line is drawn through each of them, giving a more or less curved line according to the daily differences in the water contained in the soil. The marks are then rubbed out, and the curved line shows the monthly record. Where it is stated that there is 10 per cent of moisture in the soil, it means that on that date 10 per cent, or one-tenth of the weight of the soil in its natural position in the field to a depth of one foot from the surface, is water. When 20 per cent of water is present, it means that 20 per cent, or one-fifth of the weight of the soil as it lies in the field, is water. No crops were allowed to grow on any of the plats except two in sod land and four in prairie sod.

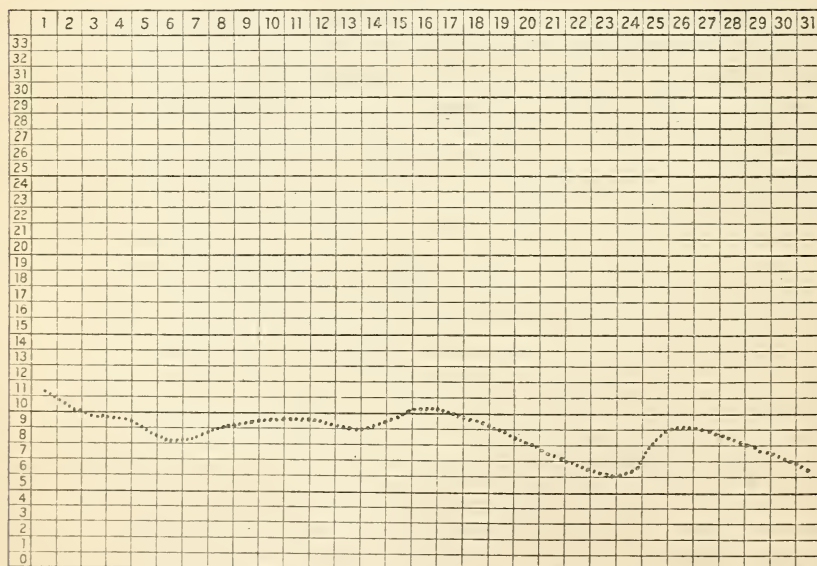
MARDELA SPRINGS, MD.



Early truck land

During the early part of the month the surface was rather too wet to cultivate. From July 5 to 10 the conditions were reported as favorable; from then until the 15th the soil was reported as too dry for crops. On the 16th about one-third of an inch of rain fell and benefited crops, but from July 18 to 24 the crops were reported as again suffering from lack of moisture. On July 25 1 inch of rain fell making the surface too wet for cultivation. On July 27 the surface was dry and the crops were reported as again suffering for rain.

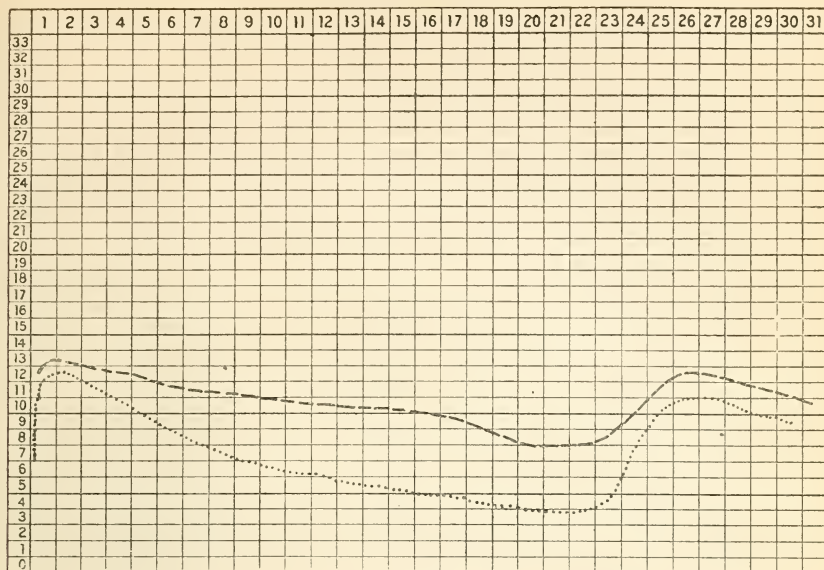
TOANO, VA.



Early truck land

The soil conditions were reported as generally favorable throughout the month for truck crops. On July 5 potatoes had matured and melons were in bloom, while other of the early truck crops were being harvested.

OXFORD, N. C.

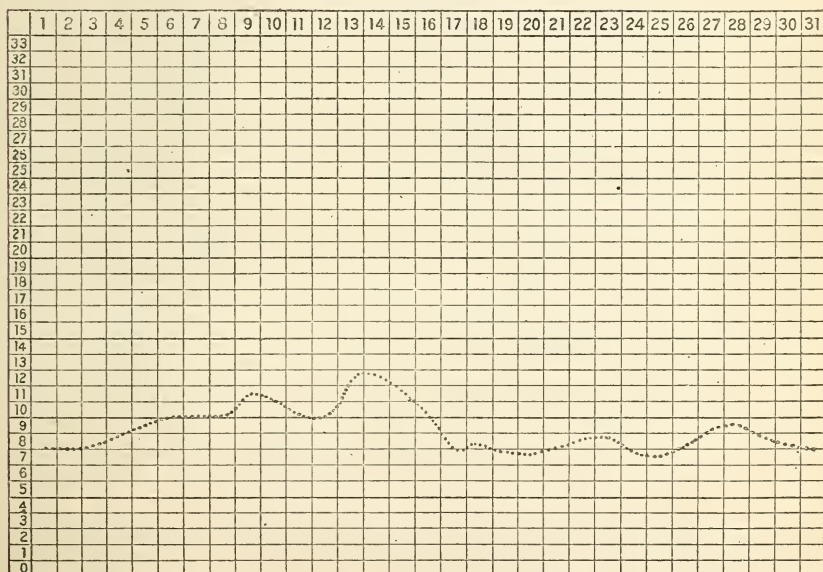


Uncultivated

Cultivated and with crop growing on land

This soil was very dry during the last week in June and the tobacco was suffering for lack of rain. A good rain occurred on July 1, which greatly benefited the tobacco crop. The conditions continued extremely favorable throughout the month, except that from July 20 to 24 they were reported as rather too dry. It will be seen from these records that in the tobacco field under actual cultivation there has been from 1 to 6 per cent more moisture than in the uncultivated land, notwithstanding the fact that the growing plants must have transpired great quantities of water. The effect of cultivation in conserving the moisture is thus made very apparent in the gradual fall of the moisture curve as compared with the more abrupt descent of the curve representing the moisture conditions in the uncultivated land. For fifteen days, with no appreciable rainfall, there was maintained, through cultivation, from 4 to 6 per cent more moisture, or nearly twice as much, in the cultivated field as in the uncultivated.

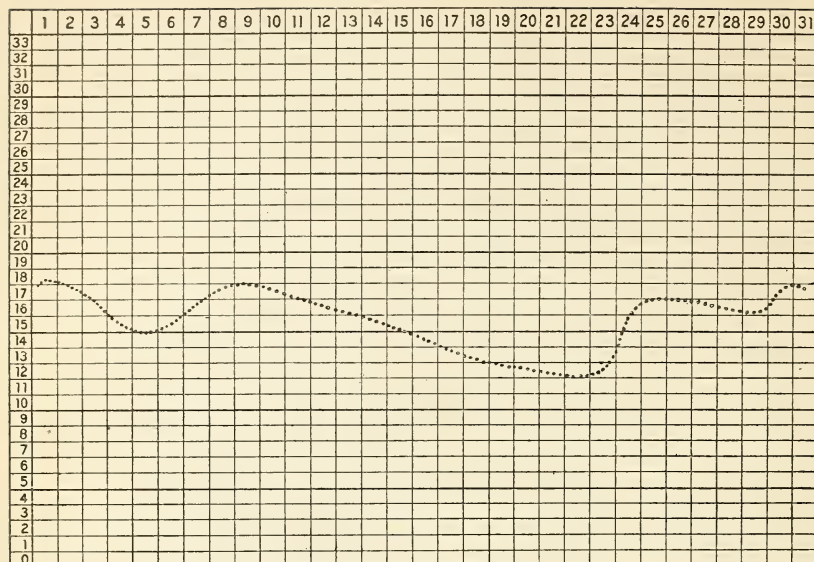
POQUONOCK, CONN.



Cultivated land bare of vegetation

These records are from a typical tobacco soil of the Connecticut Valley, adapted to the Sumatra type of cigar wrappers. The conditions throughout the month were reported as extremely favorable.

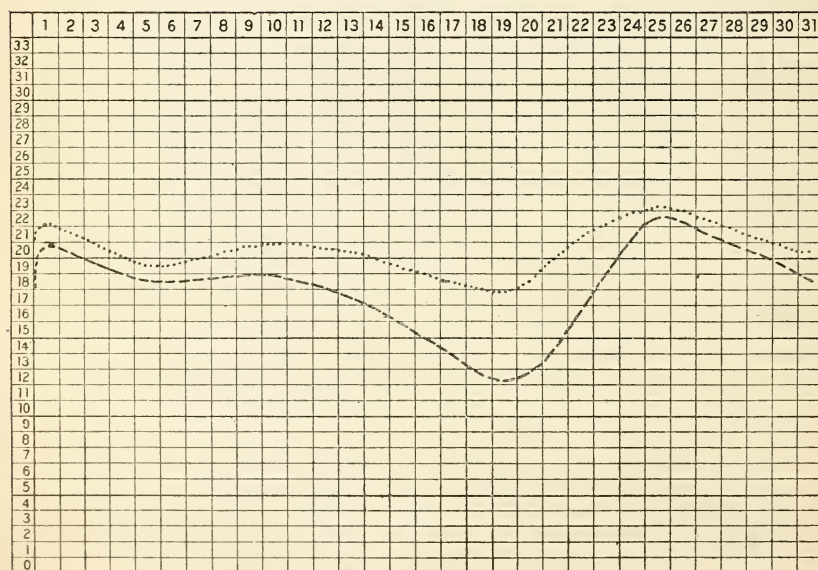
NEWSTEAD, KY.



Dark shipping-tobacco land

Conditions reported as very favorable for tobacco. From July 24 to 31 the surface was reported as too wet for cultivation.

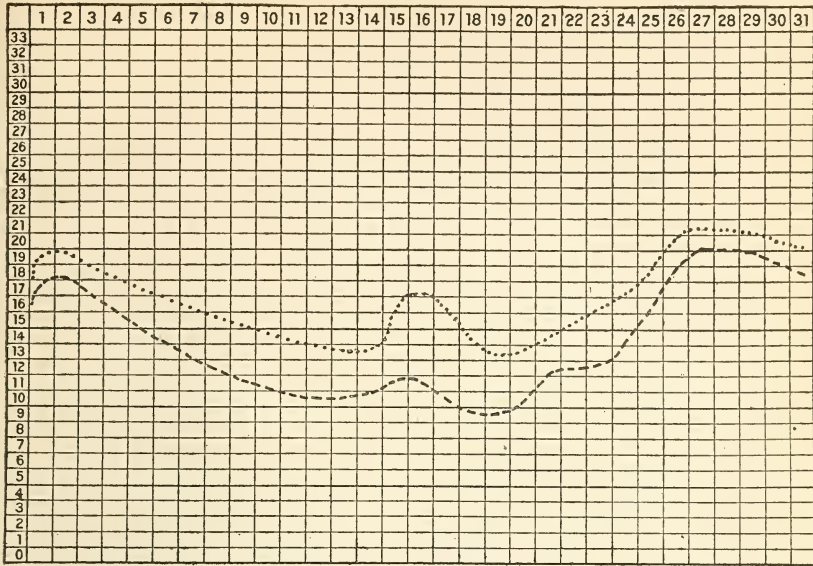
LEXINGTON, KY.



Uncultivated Grass land -----

These records have been discussed on a previous page. The conditions were generally favorable for the pasture grasses, except from July 17 to 20, when the conditions were reported as rather dry. As in June, the grass is seen to be a great drain upon the soil moisture throughout the month.

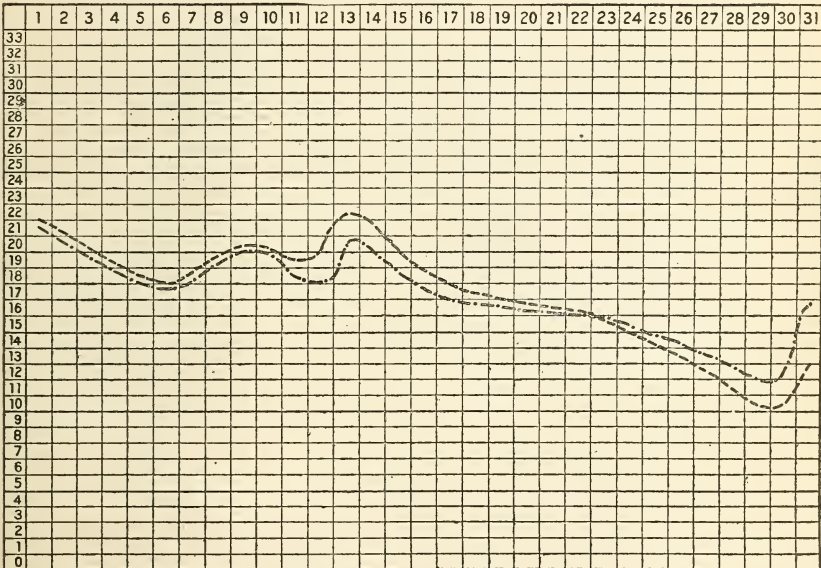
GREENDALE, KY.



Uncultivated..... Grass land -----

Conditions reported are similar to those at Lexington. They were generally favorable except during the middle of the month, which was reported as too dry.

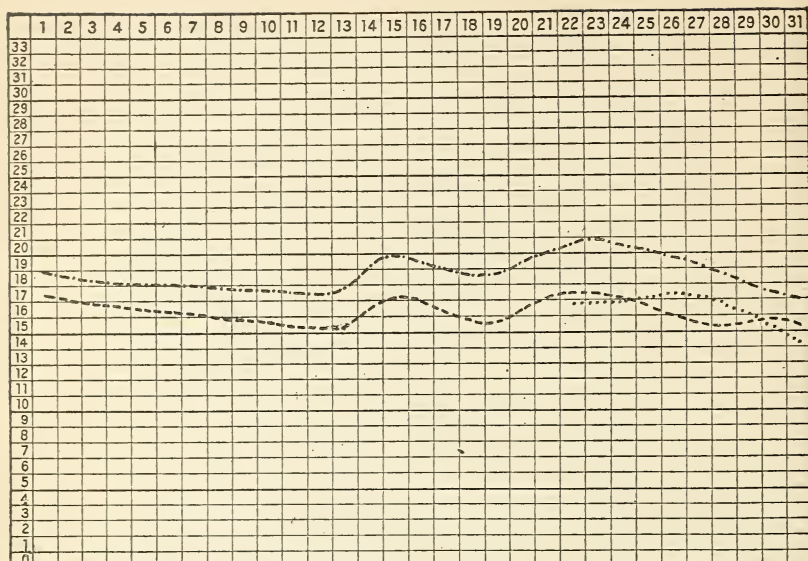
WELLINGTON, KANS.



Cultivated ----- Subsoiled

The conditions were reported as generally extremely favorable, except during the last week of July, when the soil was reported as being too dry. As stated in Bulletin No. 1, the subsoiling at this place was done during the very dry season immediately preceding the commencement of the observations. For these reasons it was not very effectually done, and it was some time after the subsoiling had been done before the rain of June 1 ended the prolonged drought which had been in progress.

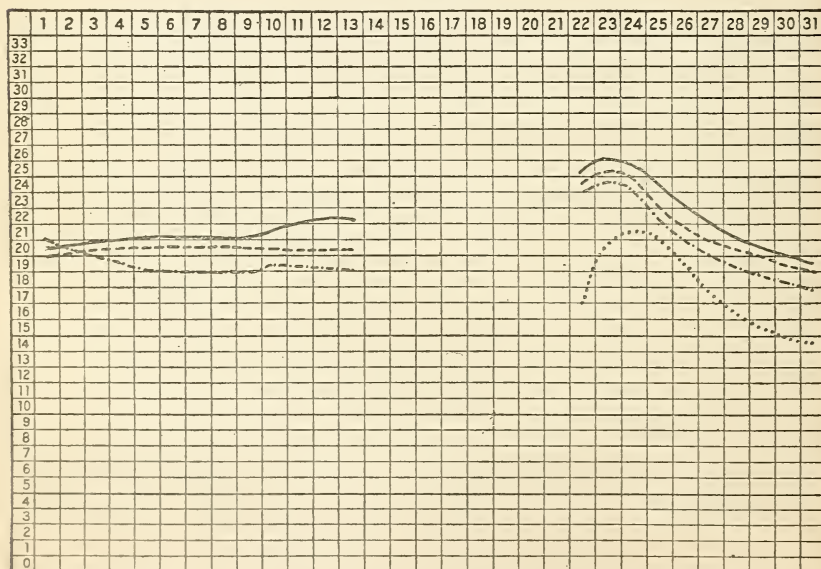
PHILLIPSBURG, KANS.



Uncultivated Cultivated ----- Subsoiled -

The conditions were reported as extremely favorable throughout the month, as frequent showers prevailed, and there was quite a rank growth of vegetation. On the last day of the month the conditions were reported as rather dry, from the dry, hot weather which was then prevailing. On that date the upland corn was reported to be slightly burned; most of the wheat had been harvested. The subsoiled field shows uniformly from 1 to 3 per cent more moisture than the soil under ordinary cultivation.

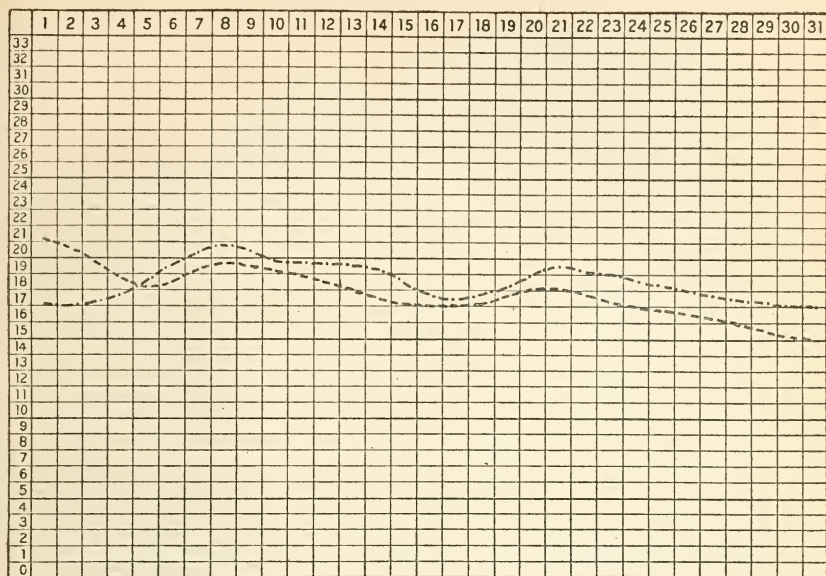
SCOTT, KANS.



Prairie sod Cultivated ----- Subsoiled - Irrigated -

The conditions were reported as very favorable during the first part of the month. On July 22 to 23, 2½ inches of rain fell, which thoroughly soaked the ground and delayed the already late harvest. Wheat harvesting began on July 26, and the yield was considered an average yield for that locality.

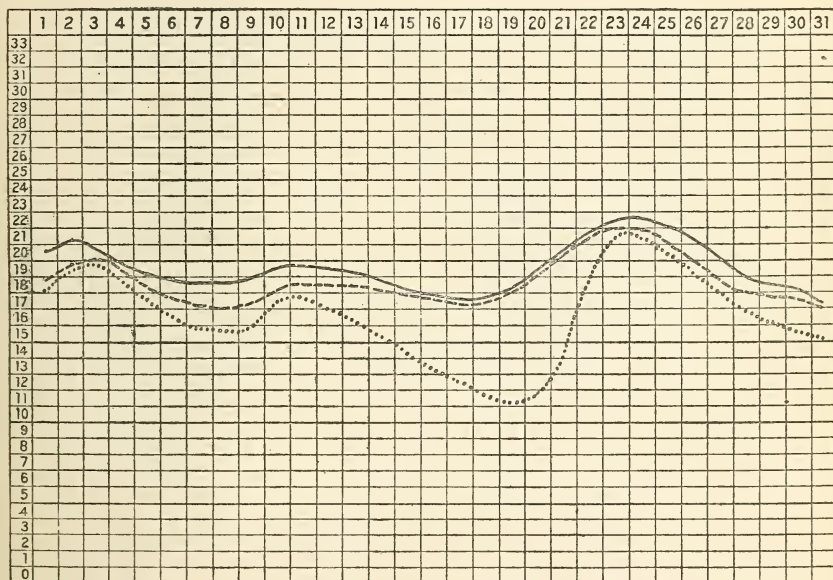
HAVEN, KANS.



Cultivated ----- Subsoiled

The conditions were reported as very favorable throughout the month, except that immediately after the frequent rains the surface was rather too wet for working.

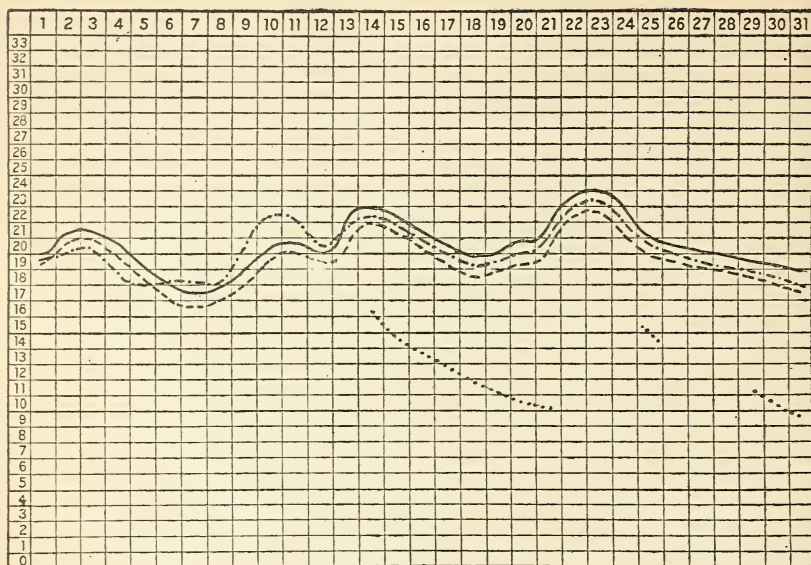
GARDEN CITY, KANS.



Uncultivated Cultivated ----- Irrigated

The conditions were extremely favorable throughout the month, and irrigation was not needed, as the cultivated field was sufficiently moist throughout the period for the need of the crops. The season was exceptionally favorable for this locality and for this season of the year.

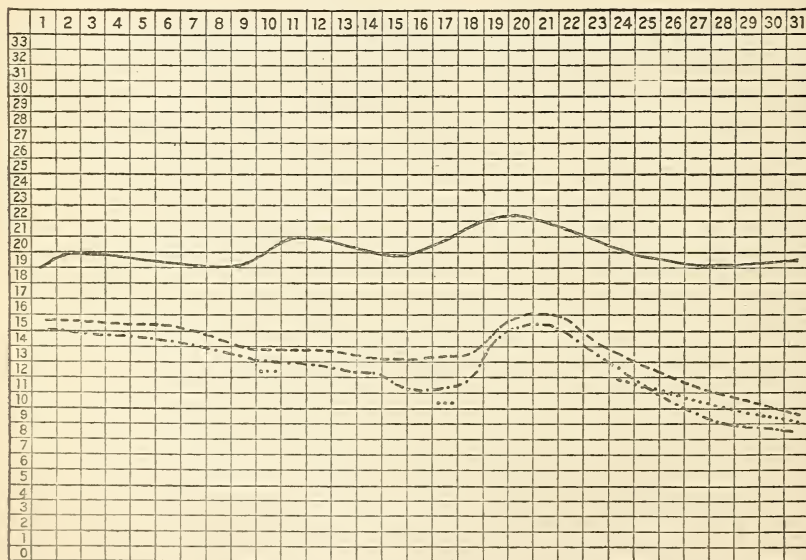
COLBY, KANS.



Prairie sod..... Cultivated ----- Subsoiled Irrigated ————

The conditions were reported as very favorable for the staple crops during the month, with frequent rains. The conditions in all the cultivated plots were quite uniform, but the few records of the moisture under the prairie sod show a very marked effect of cultivation in conserving the moisture at this place.

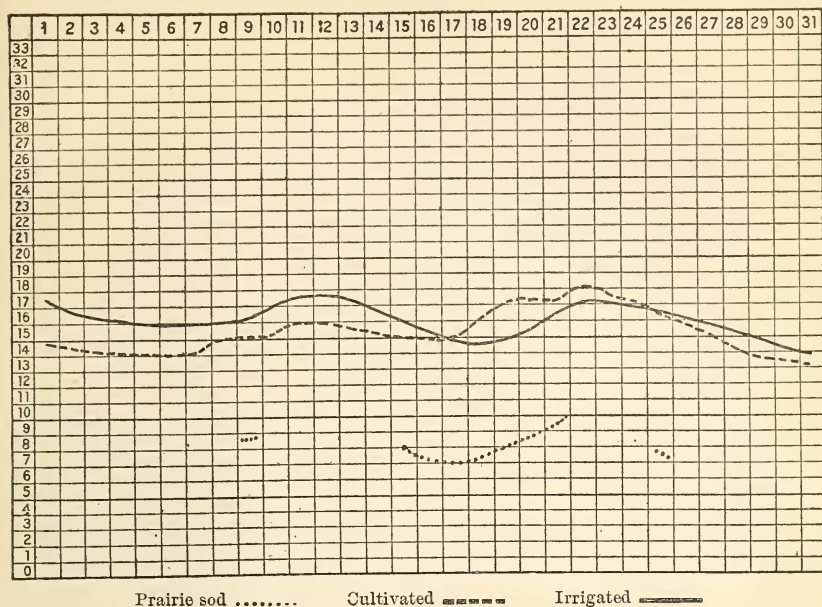
STAFFORD, KANS.



Uncultivated Cultivated ----- Subsoiled Irrigated ————

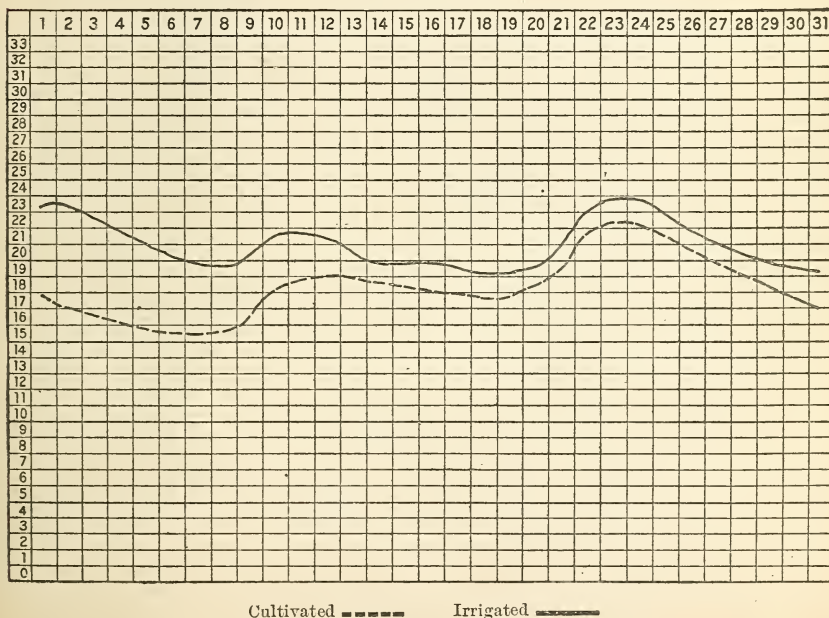
The soil conditions were reported as generally favorable throughout the month, except on the last three days, when they were reported as too dry. Irrigation was resorted to on the irrigated plot, and water was applied July 1 and 10. It is seen that the moisture curve for the irrigated field is from 4 to 8 per cent higher than in any of the fields under dry farming. No crops were growing on any of these plots, but the yield of potatoes on the adjoining irrigated field was said to have averaged about 160 bushels per acre. The soil at this place is said to be underlaid with a hardpan, and the conditions are such that there is seldom a full crop upon the locality where these samples have been taken except under irrigation.

ELLINWOOD, KANS.



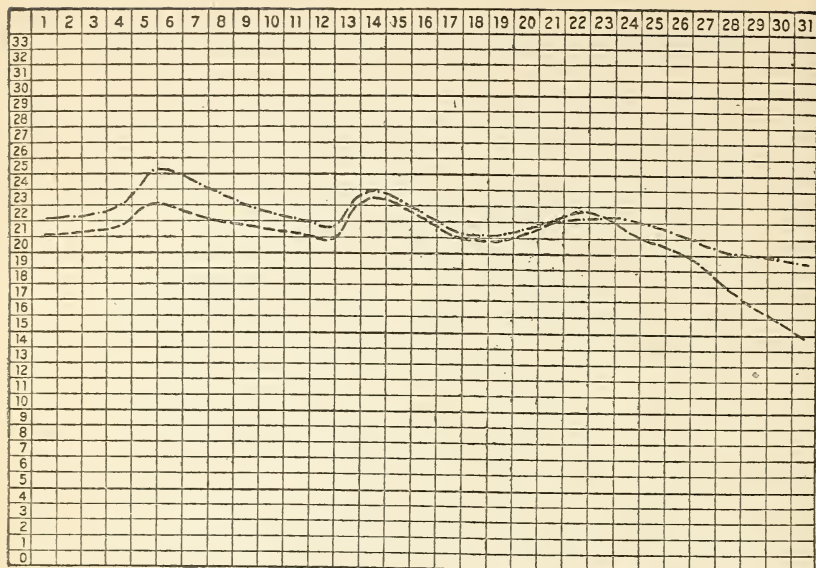
The conditions were not as favorable at this place as were those at other places in Kansas from which reports were received. The conditions were too dry during most of the month. The observer does not report the application of water to the irrigated plot and the records do not indicate its use. This soil is rather light in texture and requires frequent rains to maintain a proper water content. A few observations taken in the prairie sod show that the effect of ordinary cultivation was to maintain twice as much moisture in the soil as is contained under the prairie sod.

FOWLER, KANS.



The conditions were reported as very favorable throughout the month, with frequent showers, giving an excellent prospect for crops.

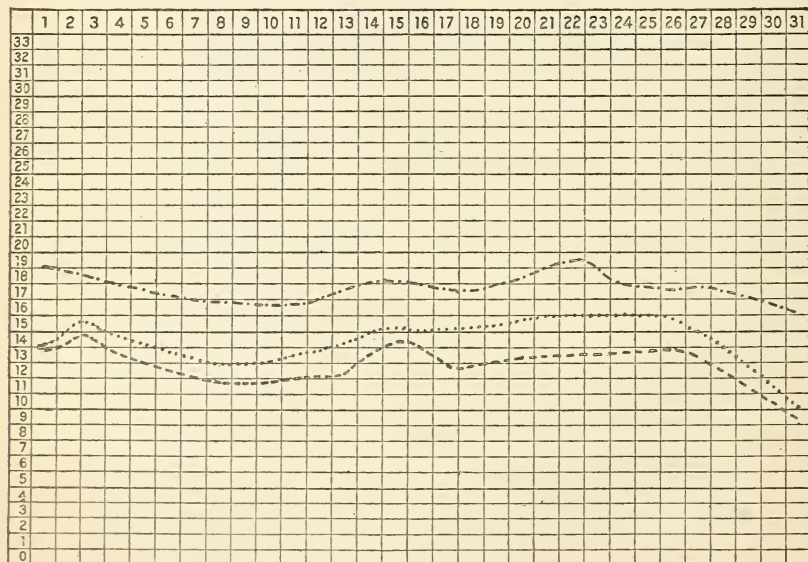
MANKATO, KANS.



Cultivated ===== Subsoiled

The first part of the month the weather was hot and sultry, with frequent showers. Crops were reported in a very flourishing condition until the 25th, when hot winds commenced and continued at intervals during the rest of the month, causing considerable damage to the corn crop. The records appear to show that the field under ordinary cultivation lost more moisture from these hot winds than that which had been subsoiled.

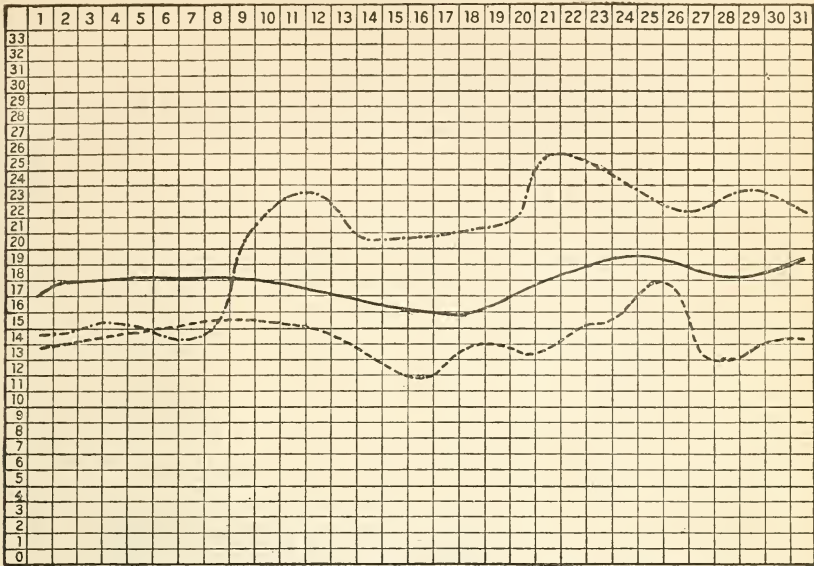
GENEVA, NEBR.



Prairie sod Cultivated ===== Subsoiled

Very meager reports were received of the conditions at Geneva, except that there was a dry period during the first third of the month. As was pointed out in the May and June records, this is the only place from which records have been taken from subsoiled fields where the subsoiling had been done a sufficient length of time before the observations commenced to insure a thorough soaking of the land. The effect of the subsoiling upon the water content of the soil has been very marked throughout the season. During this month there was from 2 to 4 per cent more moisture in the subsoiled field than under the prairie sod, while the field under ordinary conditions of cultivation which prevailed in that locality appears to have even less moisture than was found under the prairie sod.

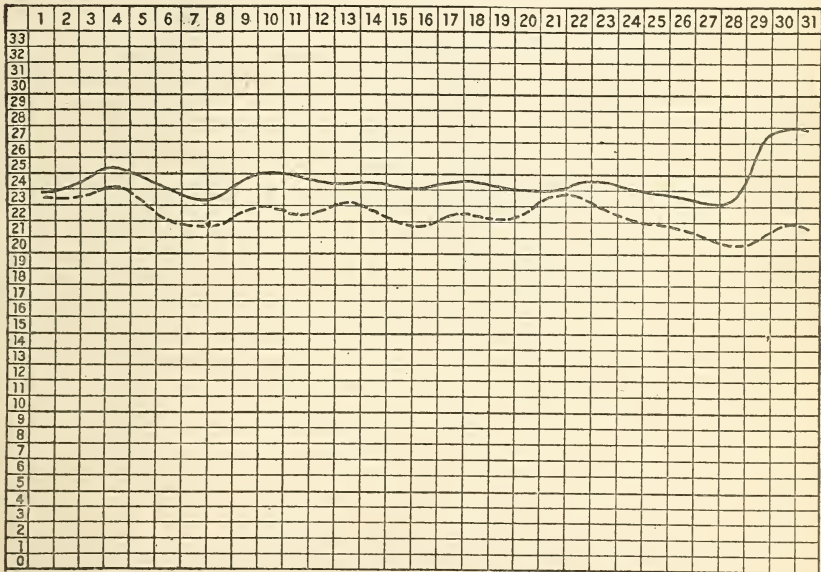
BIG SPRINGS, NEBR.



Cultivated ----- Subsoiled Irrigated —————

The conditions were reported as generally very favorable during the month, with a prospect of an excellent corn crop on the irrigated land, and from one-fourth to one-half a normal yield of crop on the land under ordinary conditions of cultivation. The records from the subsoiled field are quite irregular, and appear to show a much higher water content than from either of the other plots. The subsoiled plot appears to be very uneven in character.

NORTH PLATTE, NEBR.



Cultivated Irrigated —————

Conditions were reported as generally very favorable throughout the month. These records were taken from a bottom land, which probably accounts for the very high water content shown at this place throughout the season.

